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SEEDS 5

The Energy Literacy Series

SRA

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SEEDS 5
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ACTIVITY 1

The Many Forms of Energy

Is Energy Being Used?

We can't see, hear, or touch "energy," but energy is all around us. How can we tell that energy is being used? Think what happens when a candle burns. We can see light from the flame. The flame may flicker or move. We may hear a crackle or splutter as the candle burns. If we put our hand near the flame, we can feel its heat. We can also see the candle melt and change shape.

Whenever we observe a change, we know energy is being used. So when heat, light, sound, or motion occur, energy is being used.

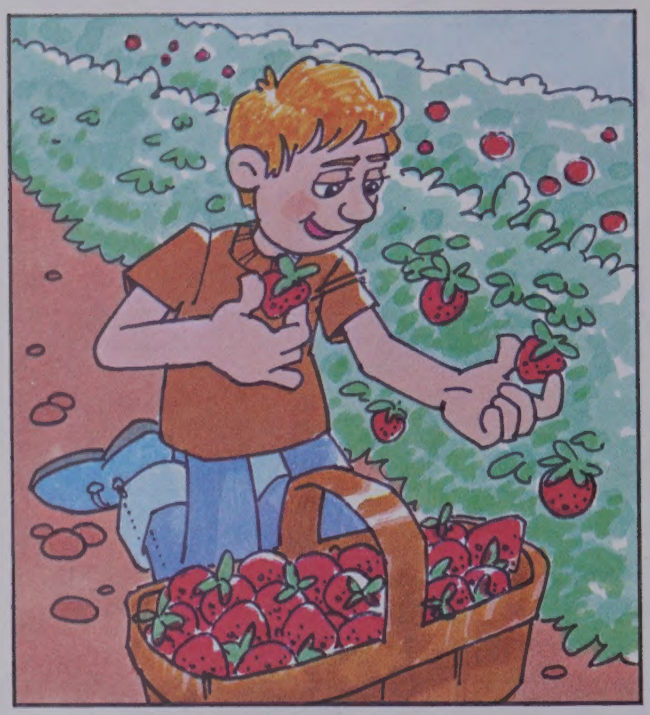
Sometimes, the energy in nature is very powerful. Lightning can make the entire night sky very bright.

Moving water can have a lot of energy too. When energy is not controlled, it can cause much damage.

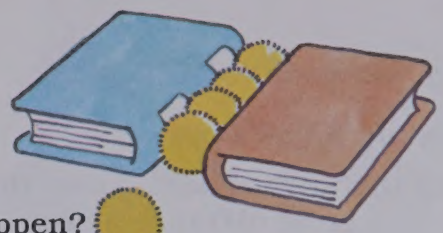
ACTIVITY 2

The Energy of Motion

Examine these pictures. You can see a person or a machine doing work. Both are using motion to do the job. Motion is a useful form of energy.



To find out about the energy in moving things, try these experiments. Read each step carefully. Everyone should have a turn.



What will happen?

A

1. Each group will need a tennis ball and a hard rubber ball. Choose a partner in your group. Each set of partners should choose a different type of ball. Stand about two metres apart and gently roll the ball to and from your partner about six times.
2. Exchange balls with the other pair in your group and repeat step 1. Try to make the ball roll at the same speed as the speed of the ball you used first.
3. Each pair needs one tennis ball. Throw the ball back and forth about six times. Each time throw the ball a little harder.

Answer these questions:

a) Which of the two balls did you have to push harder in order to keep the same speed for both balls? Why?
b) Does the ball move faster as you throw harder?
c) When is it easier to catch the ball?
d) When do you think the ball has more energy, when it is moving slowly or quickly? Why?

B

1. Each group will need two tennis balls and one rubber ball. First, practice rolling a tennis ball until you can make it move at an even speed. Don't make it roll too fast.
2. Place one tennis ball on the floor. Make sure that it is still, or stationary. Roll the other tennis ball so that it hits the stationary tennis ball head-on. Watch the result.
3. Now repeat step 2, but use the rubber ball to hit the stationary tennis ball. Make sure your rubber ball has the same speed as your moving tennis ball had in step 2. Watch the result.

Answer these questions:

a) What happened to the stationary ball in each step? Why?
b) In which step was the stationary ball moved the least distance? Why?
c) In which step was the stationary ball moved the farthest? Why?

ACTIVITY 3

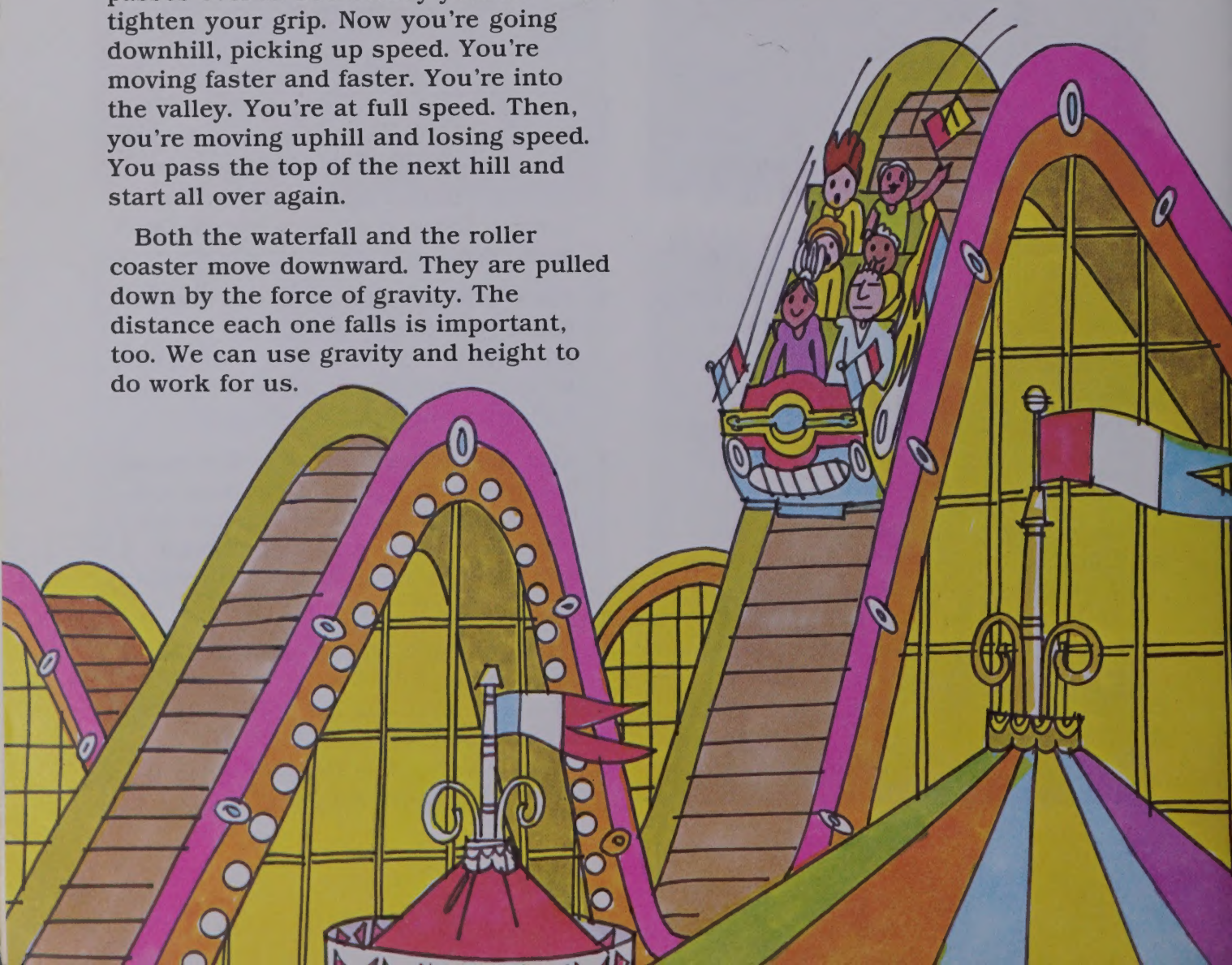
Energy Can Be Stored

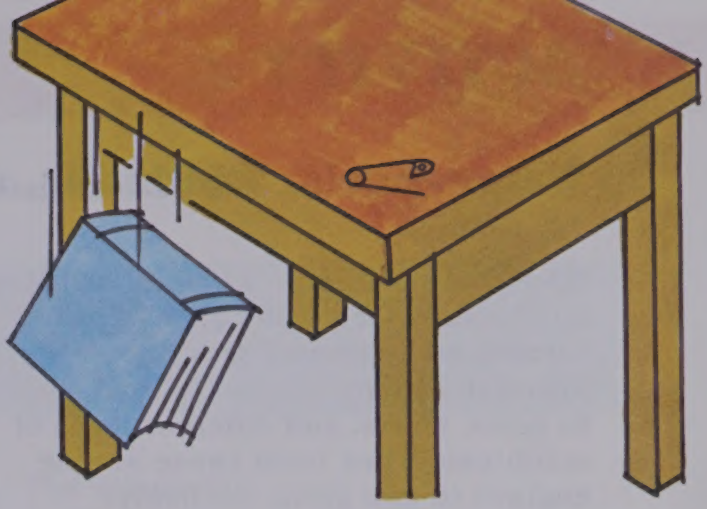
Waterfalls and Roller Coasters

Look at all that water pouring over the cliff. It falls a great distance before reaching the bottom. Think of the energy it has at the bottom. The water is churning, bubbling, and sending up spray. Can you imagine the sound it makes? Think what we could do with all this energy.

Have you ever seen a roller coaster? Did you notice that the first hill is higher than the rest of the ride? Imagine what happens on the ride. The train slowly climbs the first, high hill and passes over it. You steady yourself and tighten your grip. Now you're going downhill, picking up speed. You're moving faster and faster. You're into the valley. You're at full speed. Then, you're moving uphill and losing speed. You pass the top of the next hill and start all over again.

Both the waterfall and the roller coaster move downward. They are pulled down by the force of gravity. The distance each one falls is important, too. We can use gravity and height to do work for us.

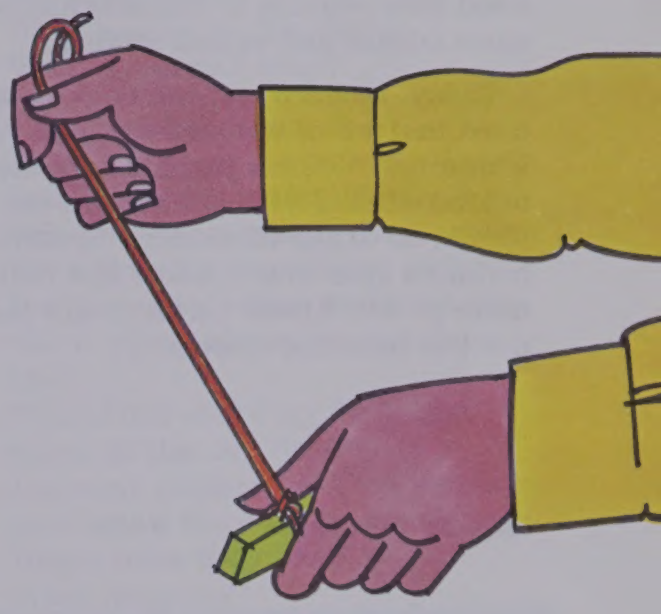




Answer these questions:

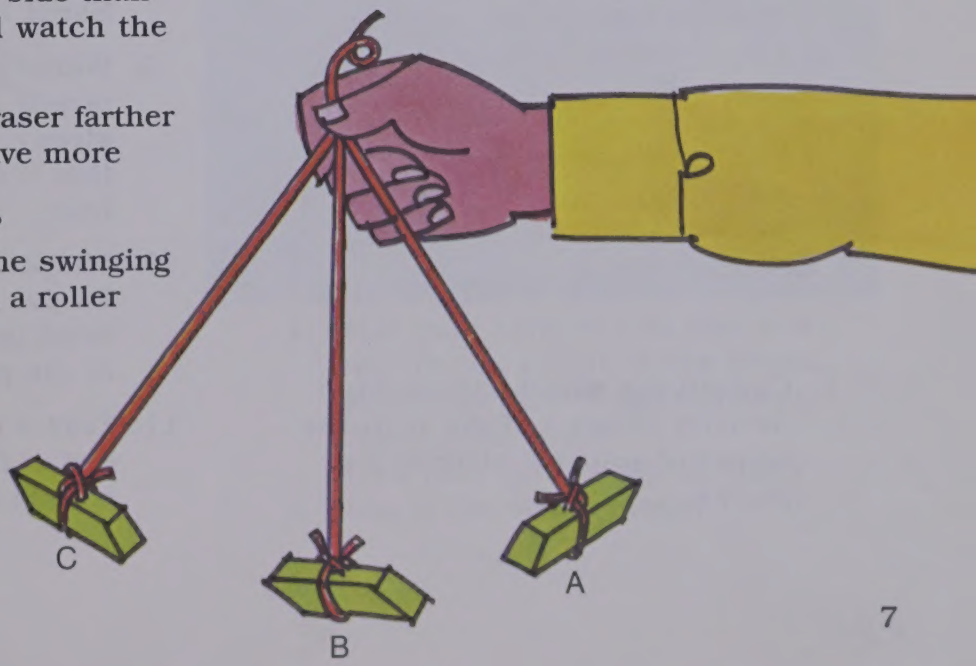
1. How long could your book and safety pin sit on your desk?
2. What kind of energy do they have on your desk?
3. Which one has more of this kind of energy?

Take your string and tie it around the middle of your eraser. Hold up the string so your eraser is dangling and still. Now move the eraser out to one side. Let it go and watch the motion.



4. What type of energy did the eraser have before you let go?
5. At what point of its swing did the eraser have the most speed?
6. What kind of energy did the eraser have when it was moving the fastest?
7. How high did it rise after the first swing?
8. Name the type of energy the eraser had at each position of its swing.

Hold up the string so that your eraser is again dangling and still. Now move the eraser farther out to one side than you did before. Let it go and watch the motion.



9. When you moved your eraser farther out to one side, did it have more energy?
10. How could you see this?
11. How was the energy of the swinging eraser like the energy in a roller coaster ride?

ACTIVITY 4

Waterwheels, Windmills, and Turbines

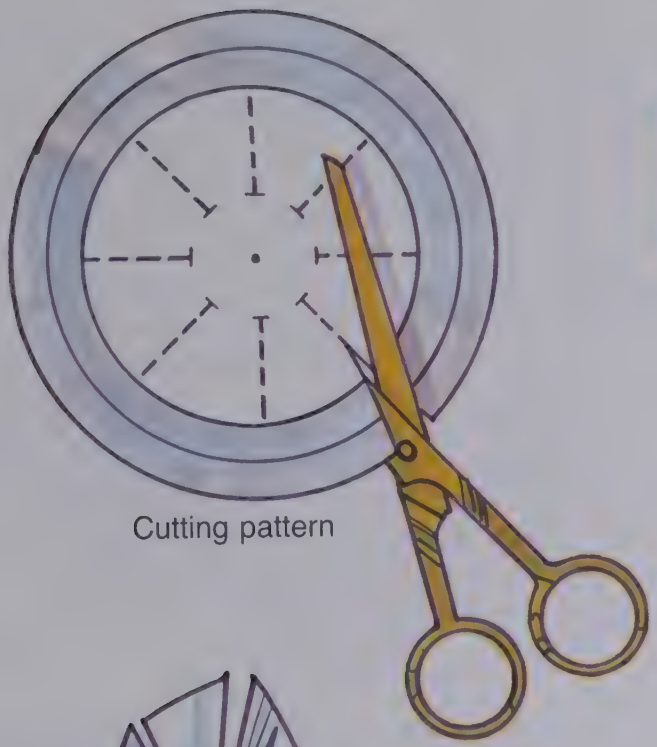
Have you ever seen a windmill whirling in a breeze? Or a waterwheel slowly turning in a stream? Our ancestors joined the shafts of these bladed wheels to gears, levers, and different types of machines. They used these simple engines to mill grain, lift heavy materials, and pump water. In the early nineteenth century, many factories used waterwheels to run machines that spun cotton and sawed lumber.

Today, modern turbine engines are used instead of waterwheels and windmills. Modern turbines are also bladed wheels with shafts that are joined to other machines. Modern turbines spin much faster and deliver more power. These turbines are mainly used to produce electricity.

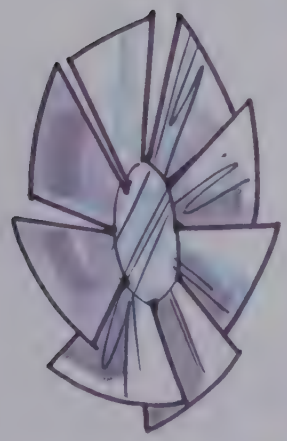
Making a Turbine

Each group will need:
- 1 aluminum pie plate
- 1 pair of scissors
- 1 paper clip
- 1 pencil
- 1 plastic drinking straw
- 1 metal nail
- masking tape
- Activity Sheet 1

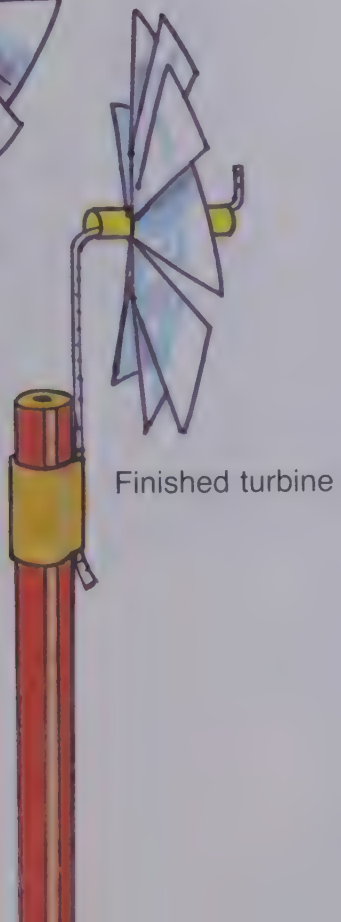
1. Cut out the wheel pattern from Activity Sheet 1. Tape it to the center of your pie plate in four places.
2. Remove the edge of the pie plate by cutting a circle on the pie plate. Leave a space of 2 cm around the wheel pattern. Make sure that the wheel pattern stays taped to the pie plate.
3. Cut along the dotted lines toward the center of the circle. Do not cut past the small solid lines.
4. Cut along the small solid lines on the wheel pattern, so that there are small cuts on both sides on the bottom of each blade.
5. Use the nail to make a hole in the center of the wheel.
6. Trim the pie plate by cutting along the outer edge of the wheel pattern. Remove the wheel pattern from the pie plate.
7. Bend each blade of the wheel slightly toward the center of the wheel.
8. To make the shaft, cut a piece of drinking straw so that it is the same size as the one shown on Activity Sheet 1.
9. Widen the hole in the wheel with a pencil. Put the piece of drinking straw through the hole. Make sure that the shaft fits snugly in the hole.
10. Shape a paper clip into a long "L." Fit the shaft on the long end. Then bend the long end down as shown in the picture.
11. Take a pencil and tape it to the long end of the paper clip. Your turbine should now look like the drawing.



Cutting pattern



Bending blades



Finished turbine

Using Your Turbine

Each group will need:
1 aluminum tray
1 foam cup

A The Windmill

1. Blow lightly on the turbine wheel from the front.
   What happens?
2. Blow harder on the wheel.
   What happens? Why?

B The Waterwheel

1. Make a hole in the bottom of your foam cup with a nail. Widen the hole with your pencil. Then, cover the hole with your finger and fill the cup with water. Hold the cup about 20 cm above the aluminum tray.
   What kind of energy does the water in the cup have?
2. Let your partner hold the turbine just below the cup. Remove your finger from the cup.
   What happens?
3. Refill the cup with water and hold it in the same position as you did before. Repeat step 2, but let your partner hold the turbine at different positions under the cup.
   Where should you hold the turbine to make it spin the fastest? Why?

C The Steam Turbine

1. Hold your turbine just over the hole in the spout of the kettle. Make sure your fingers are not close to the spout.
   Does your turbine wheel spin?
2. How is the steam made?

ACTIVITY 5

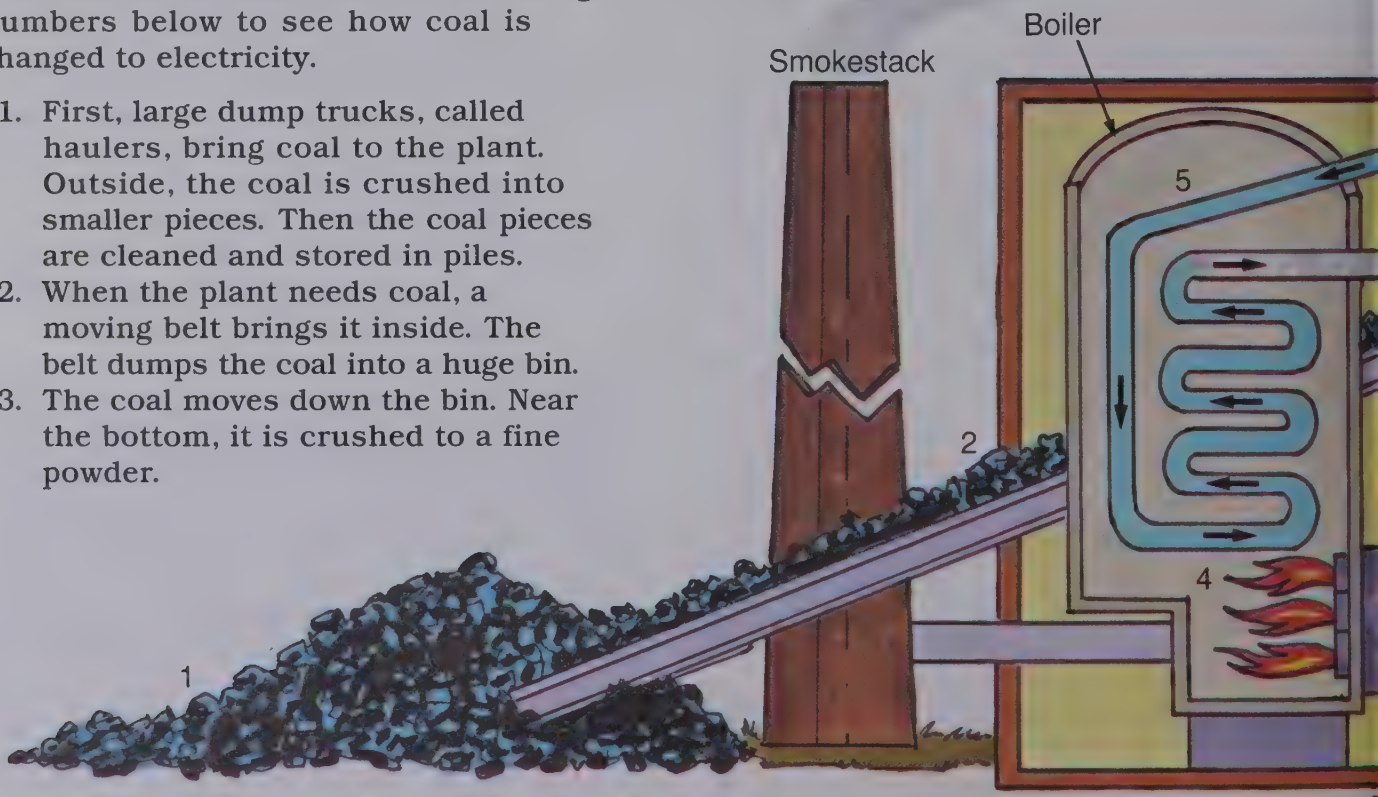
From Coal to Kilowatts

Electricity is an important form of energy. It is clean and easy to use. We use it at home all the time. Factories and stores use it, too. We run all sorts of things with electricity.

You know we can use water power to make electricity. Yet, in some places, there are no rivers to use. In other places, the rivers are not large enough. So how is electricity made in these areas? One way is to burn coal.

Look at the picture, "From Coal to Kilowatts." It shows the inside of a steam generating plant. Follow the numbers and arrows. Read the matching numbers below to see how coal is changed to electricity.

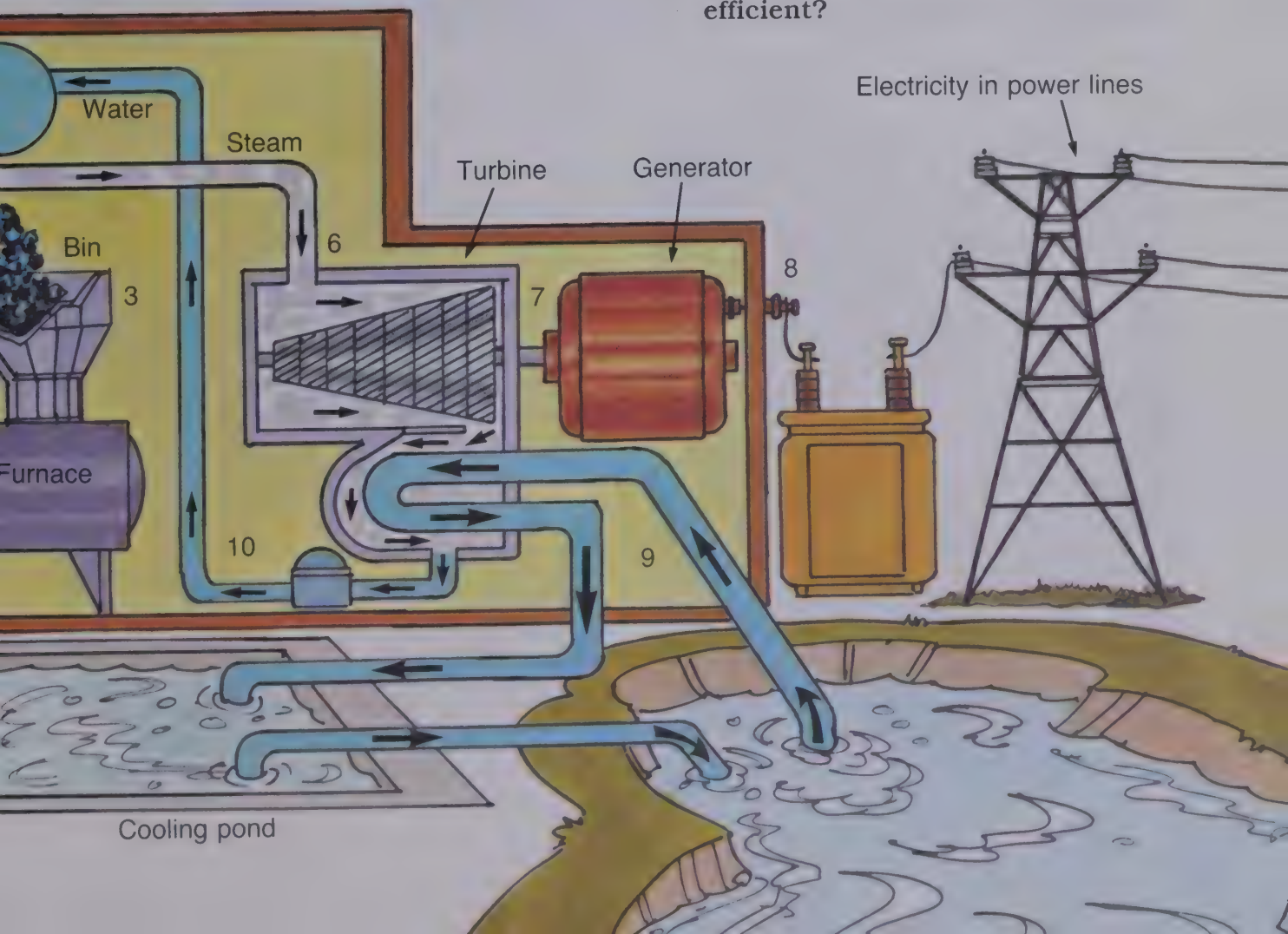
1. First, large dump trucks, called haulers, bring coal to the plant. Outside, the coal is crushed into smaller pieces. Then the coal pieces are cleaned and stored in piles.
2. When the plant needs coal, a moving belt brings it inside. The belt dumps the coal into a huge bin.
3. The coal moves down the bin. Near the bottom, it is crushed to a fine powder.
4. The coal powder is mixed with air. This mixture is blown into the furnace. Here, it is set on fire.
5. The boiler has many tubes that carry water. This water comes from a nearby lake or river. The fire in the furnace heats the water inside the tubes. The water changes to steam.
6. The hot steam rushes to the turbine. The steam makes the turbine blades and shaft turn. The blades and shaft spin very quickly.
7. The turbine shaft that holds the blades also turns the generator.



8. When the generator spins, it makes electricity. The electricity is sent to our homes through wires. We call these wires power lines.
9. Water from a nearby lake or river cools the used steam. This water is pumped to a cooling pond. Then the water is returned to the lake or river.
10. The cooled steam condenses; that is, it changes back to water. A pump returns the condensed steam to the boiler. Can you see where water changes first to steam and then back to water?

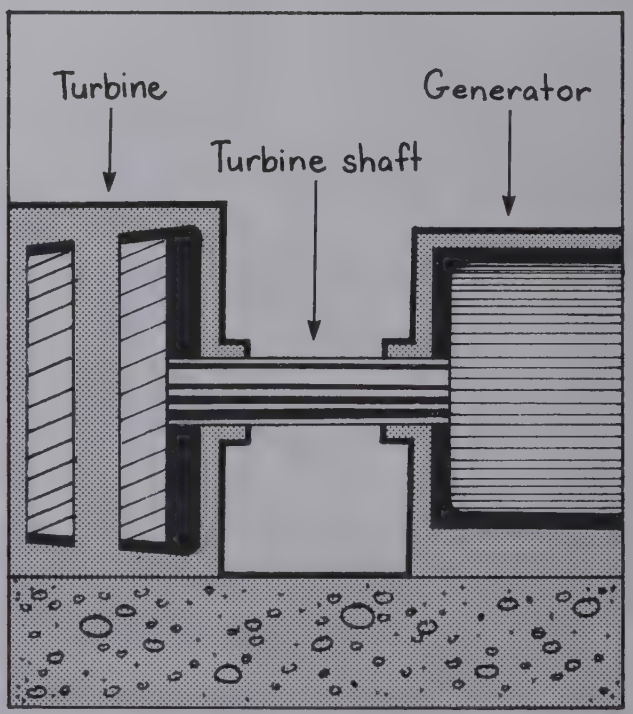
Answer these questions:

1. What kind of trucks bring coal to the plant?
2. Is the coal taken inside the plant right away? Why?
3. Where does the belt take the coal?
4. What happens near the bottom of the bin?
5. What happens to the coal next?
6. What happens to the coal in the furnace?
7. Explain what happens in the boiler.
8. What happens in the turbine?
9. What does the turbine shaft do?
10. What does the generator do?
11. What happens to the used steam? How is this done?
12. Is the "coal-to-kilowatts" process efficient?



This coal-fired steam generating plant makes about four million kilowatts of electricity.

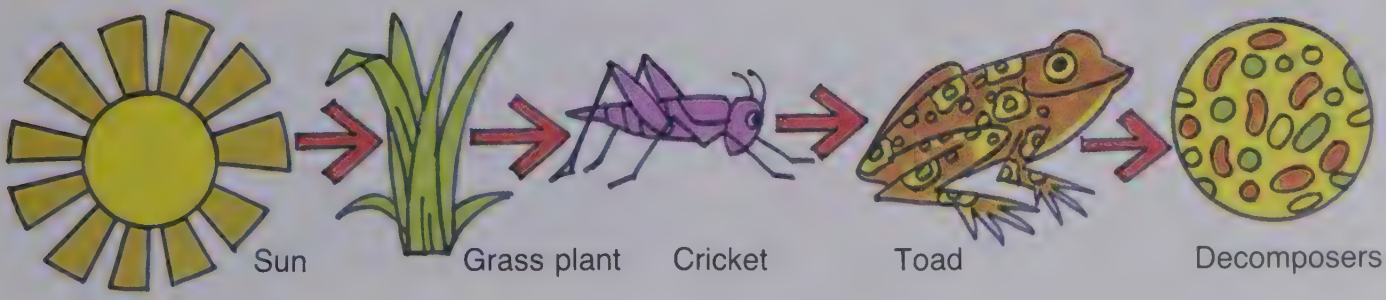
The turbine room



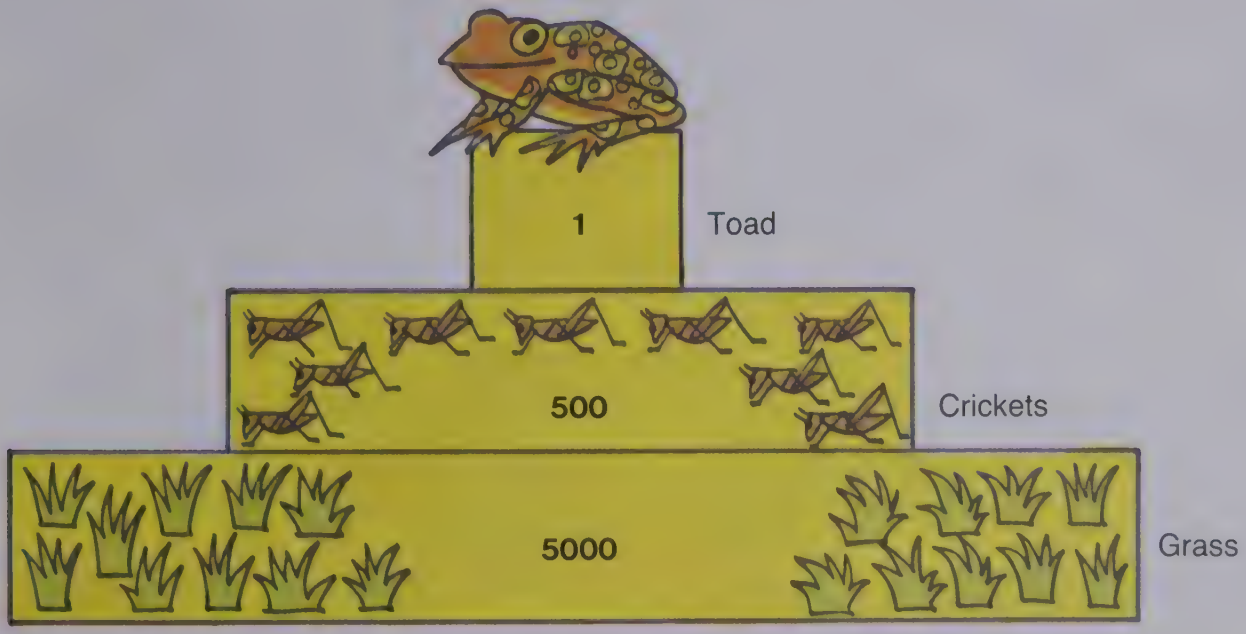
The turbine shaft spins the generator.

ACTIVITY 6

The Energy Flow in Food Chains



This is a simple food chain showing how energy flows from producers to consumers. The last step in this food chain is the flow of energy to the decomposers.



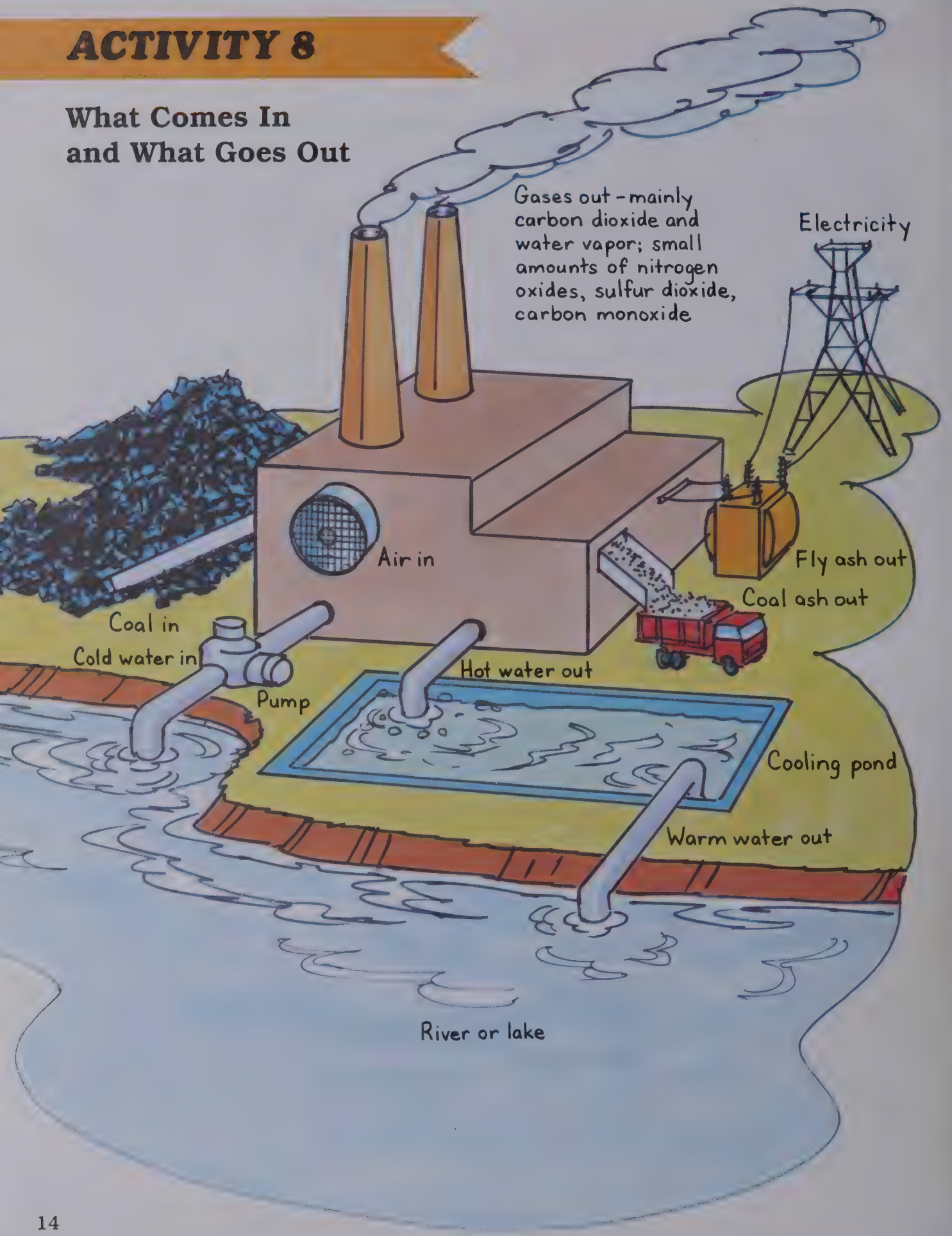
This pyramid of numbers shows how energy is lost in a food chain. It takes many crickets and many more grass plants to support just one toad at the top of the pyramid.

Answer these questions:

1. Explain the following terms: producer, consumer, food chain.
2. What do all living things need to live?
3. What is the link between the parts of the food chain?
4. Give an example of a four-part food chain.
5. Explain how energy is sent from one part of the food chain to another.
6. What is a decomposer?
7. Why are decomposers important?
8. What does the pyramid of numbers represent?

ACTIVITY 8

What Comes In and What Goes Out



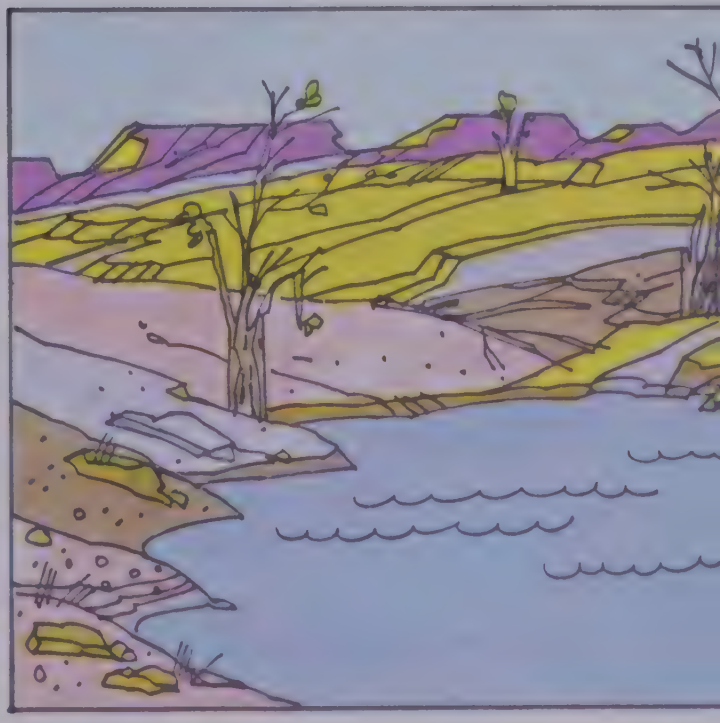
The Effect of Smoke on Living Things

You will need:
- 2 small potted plants
- 2 large jars
- 2 lids
- 5 sticks of incense
- 5 matches

1. Place one potted plant in each jar.
2. Place a stick of incense in one jar. Light the incense. Put the lids on both jars.
3. Place both jars where each will get the same amount of heat and light.
4. Make sure that each plant is watered.
5. Light a stick of incense in the same jar for four more days.
6. Observe the plants each day. Record your results.

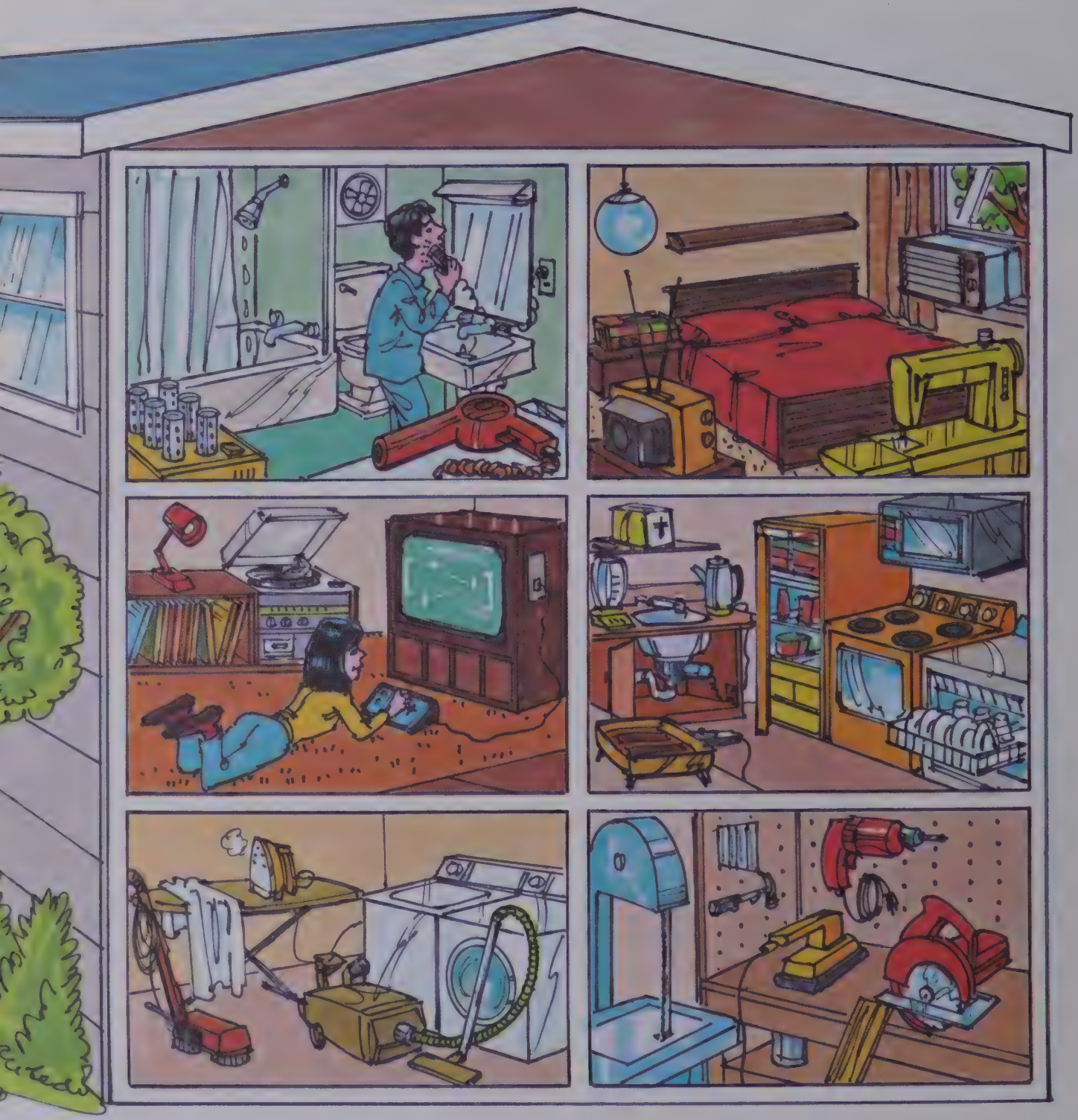
Ten years ago, an artist painted this picture of an area that is close to a coal-fired steam generating plant.

Recently, the artist returned to the same area and painted another picture. Look at what has happened.



ACTIVITY 9

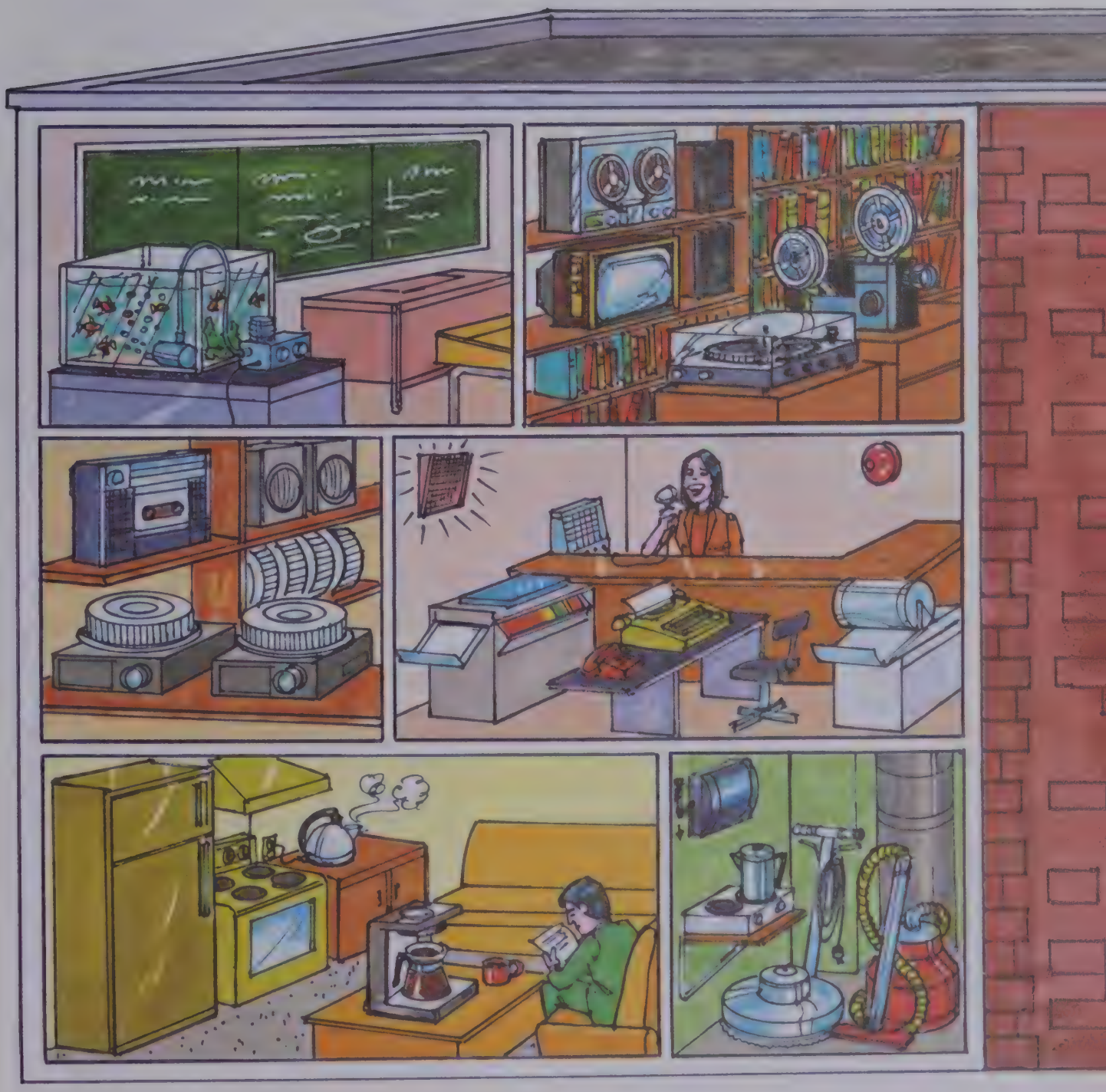
How We Use Electricity at Home



How do you use electricity at home?

ACTIVITY 10

How We Use Electricity at School

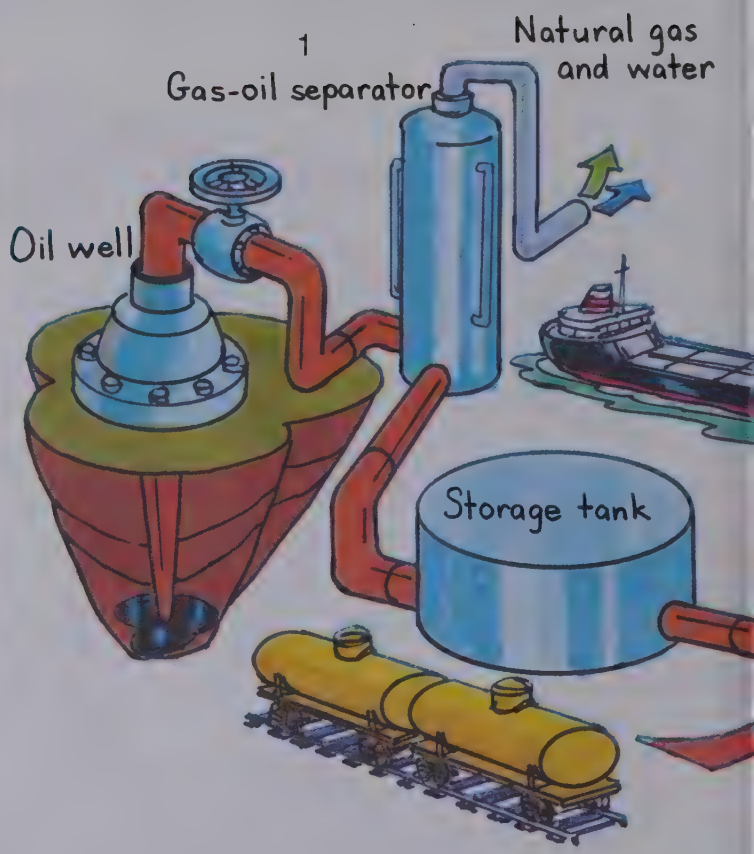


How do you use electricity at school?

ACTIVITY 11

From the Well to the Car

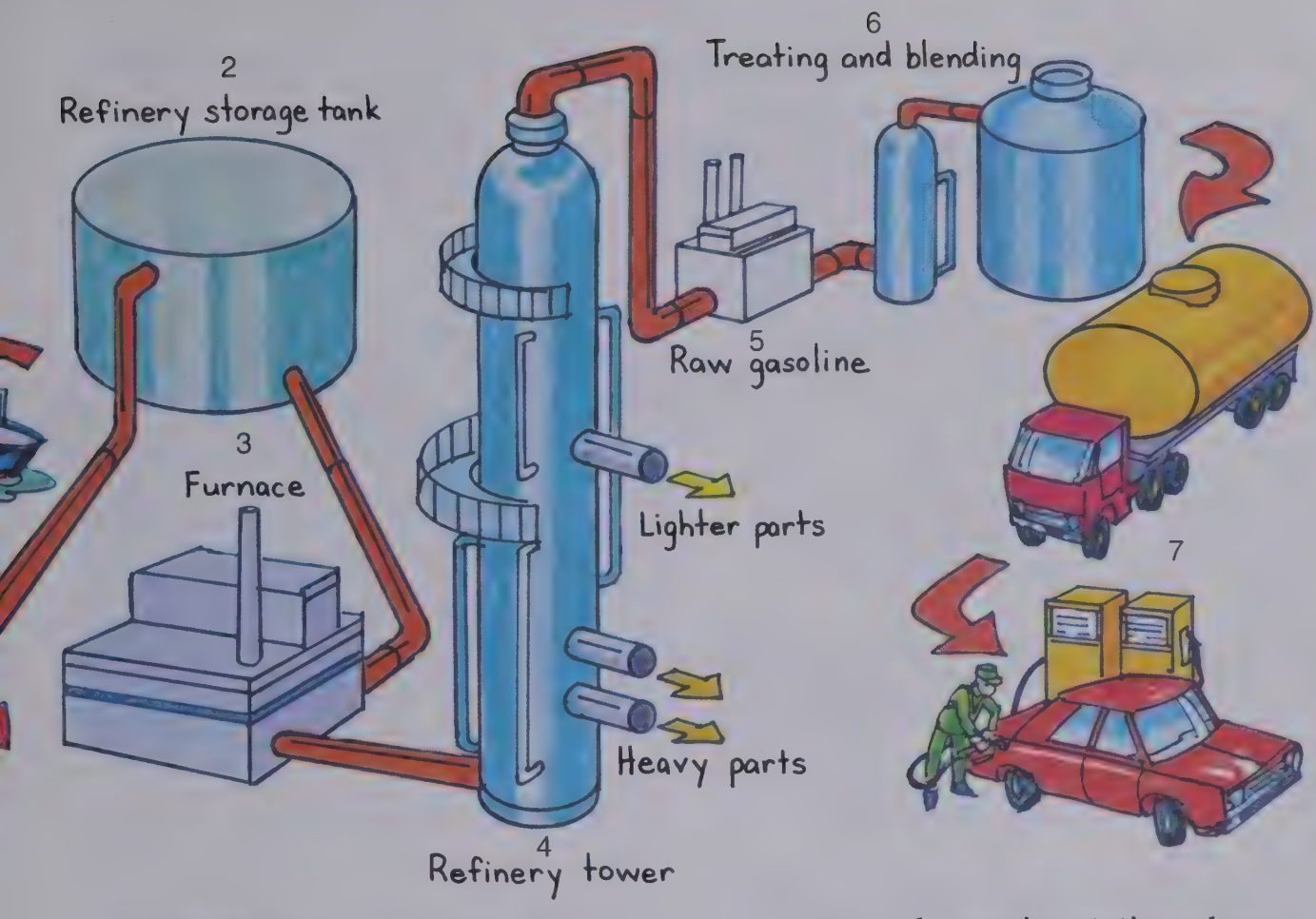
All the different substances in crude oil are separated inside tall, closed towers.



Crude oil is a fossil fuel. It formed from the bodies of plants and tiny animals that died millions of years ago. It is an amazing mixture of many different substances. Most of these are liquids. Some are gases and solids. But all of them can be burned. This is why crude oil is an important source of energy.

Once it leaves the oil well, crude oil has a long road to travel before we can use it in our cars. Look at the picture, "From the Well to the Car" and follow the path that oil takes.

1. First, the oil is separated from the natural gas and water that come with it out of the well. The oil itself is stored in tanks until it can be moved by tanker car, pipeline, or ship to the refineries.
2. When the oil is brought to the refinery, it is stored in tanks until it is needed.
3. The crude oil is then sent to the furnace in pipes. Inside the furnace, the oil is heated until most of the substances in it boil. The thin, lighter parts begin to boil first. The thick, heavy ones begin to boil later. Eventually, most of the parts turn into vapors.
4. This mixture of vapors is piped to a tall, closed tower. As the vapors rise inside the tower, they are cooled and become liquid. Each part of the vapor mixture condenses at a different level in the tower. The heavy



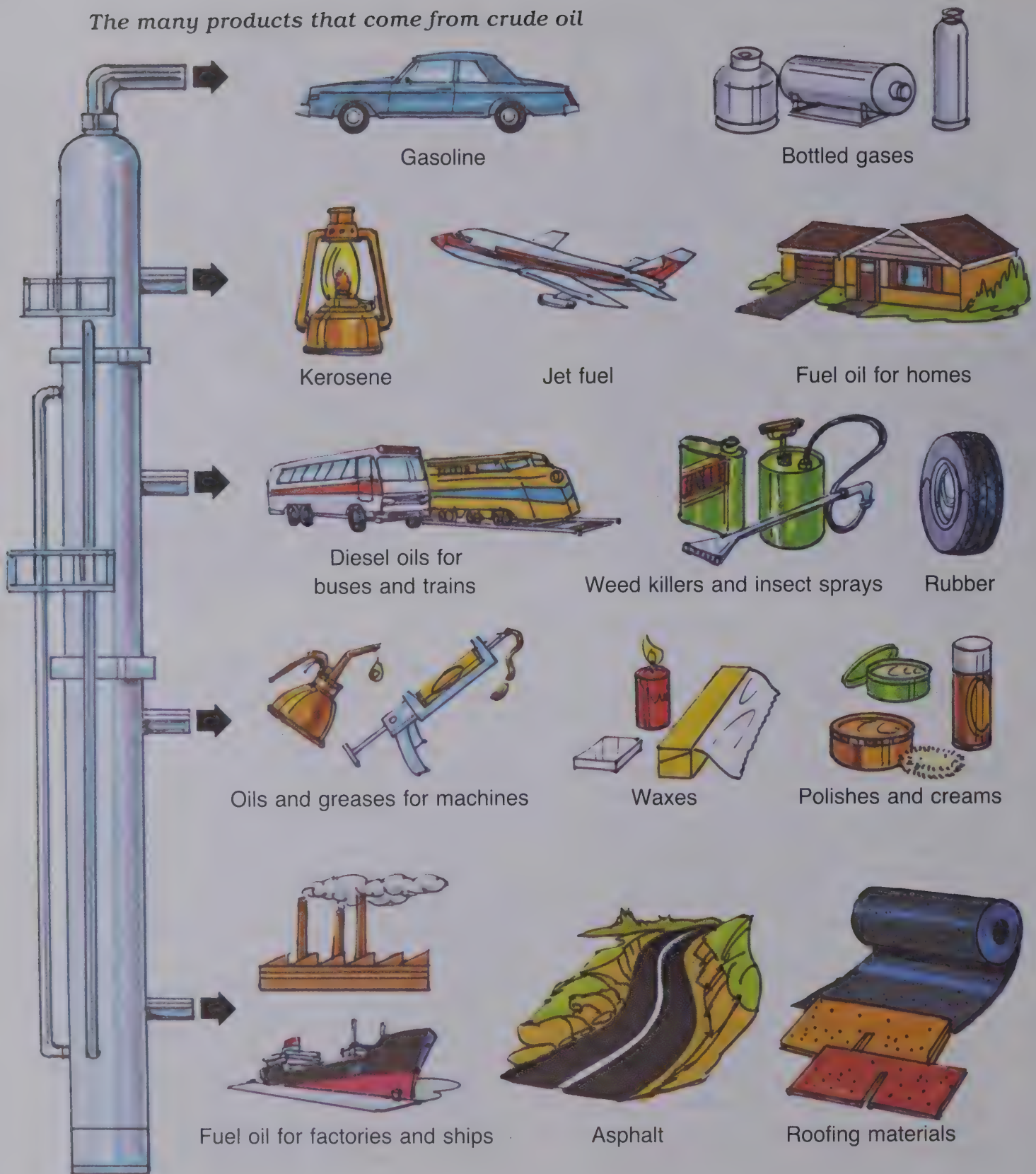
vapors turn to liquid near the bottom where it is hotter. The light gasoline vapors turn to liquid near the top, where it is much cooler.

5. The liquid gasoline is now piped to a special unit. Here the shape of the gasoline molecules is changed. This makes the gasoline strong enough to use in our cars.
6. After this, the gasoline must be treated to clean it of substances that would hurt the engines in cars. Then it is blended with other substances to make different kinds of gasoline. Some types of gasoline are used in tractors, some in trucks, and others in cars. There are even different blends of gasoline for summer and winter driving.
7. After all of this, the gasoline is ready to go to the service station where we buy it for our cars.

Answer these questions:

1. What is crude oil?
2. What does crude oil contain?
3. Why is crude oil an important source of energy?
4. What happens to crude oil before it is shipped to the refinery?
5. What happens to crude oil inside the furnace?
6. What happens to the vapors inside the tower?
7. Which part of the tower is hottest? Which is the coolest?
8. Where do the gasoline vapors condense?
9. Why is gasoline treated?
10. Why is gasoline blended?

The many products that come from crude oil



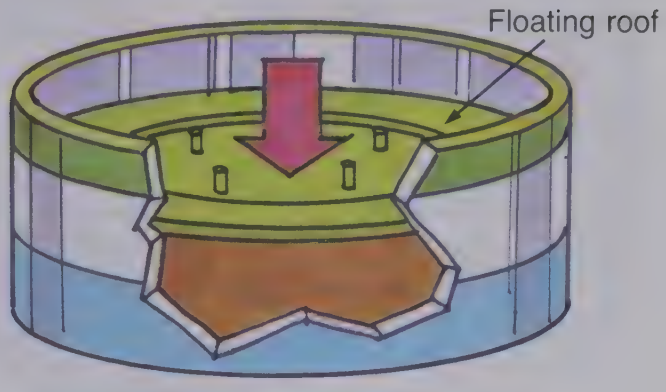
ACTIVITY 12

Oil Refining and Our Environment

Oil refineries use large amounts of water. However, they are trying to use less. Huge clouds of steam are often seen rising from refinery stacks.

Water that contains harmful by-products is put into settling ponds. The oil in the water rises to the top and can be reused. Solid materials sink to the bottom and can be used as landfill. The water can now be reused, too.

Many refinery products evaporate easily. These products are stored in tanks with special floating roofs. The roofs move up and down to keep the products covered so they won't evaporate into the air.



Refineries try to convert crude oil as cleanly as possible. However, we burn gasoline and fuel oils to run our trucks and factories and to heat our homes. It is the burning, not the refining, that causes the pollution.

ACTIVITY 13

Our Plastic World

My Plastic Morning

My plastic alarm clock woke me up. I pushed aside my sheets made of polyester and cotton and jumped off my mattress filled with plastic foam. I took off my acrylic pyjamas and put on my Fortrel top and nylon jogging pants.

In the bathroom, I used my plastic toothbrush to brush my teeth with toothpaste from a plastic tube. Then I went into the kitchen to make my breakfast. I took the bread out of its plastic bag. My slice of cheese was wrapped in plastic, too. My egg came out of a foam egg carton.

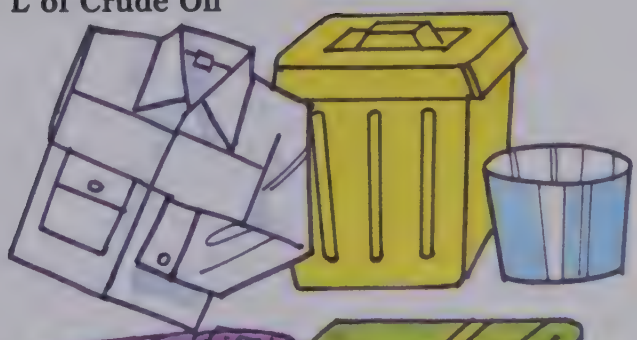
I cooked the egg in a Teflon-coated frying pan. I didn't burn my hand because of the plastic handle on the flipper.

All of this took so long that I was late. I ran across the vinyl floor tiles and out the front door. As I gripped the plastic handles on my bicycle, I heard my mother call me. I had forgotten to throw the plastic bag full of garbage into our plastic garbage pail.

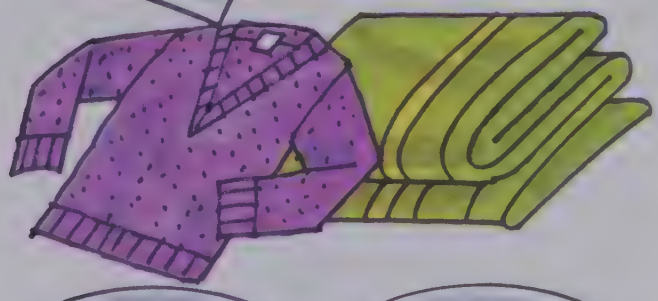
Some Products That Can Be Made From 250 L of Crude Oil

46 white shirts (76% polyester)
and 13 garbage cans

40 buckets

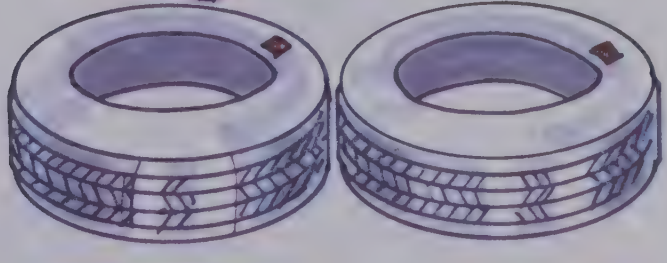


46 sweaters or 11 blankets
(100% acrylic)

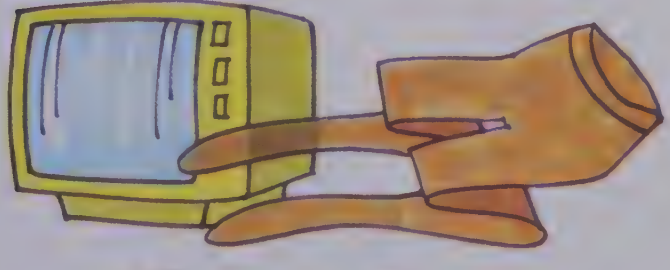


2 automobile tires or 27 bicycle tires

8 truck-tire tubes or 35 bicycle-tire
tubes



910 nylon pantyhose or
nine 40.6-cm television cabinets



350 m of home waterpipe or
815 m^3 of plastic sheet

Enough fuel oil to heat an average
house for thirty days

ACTIVITY 14

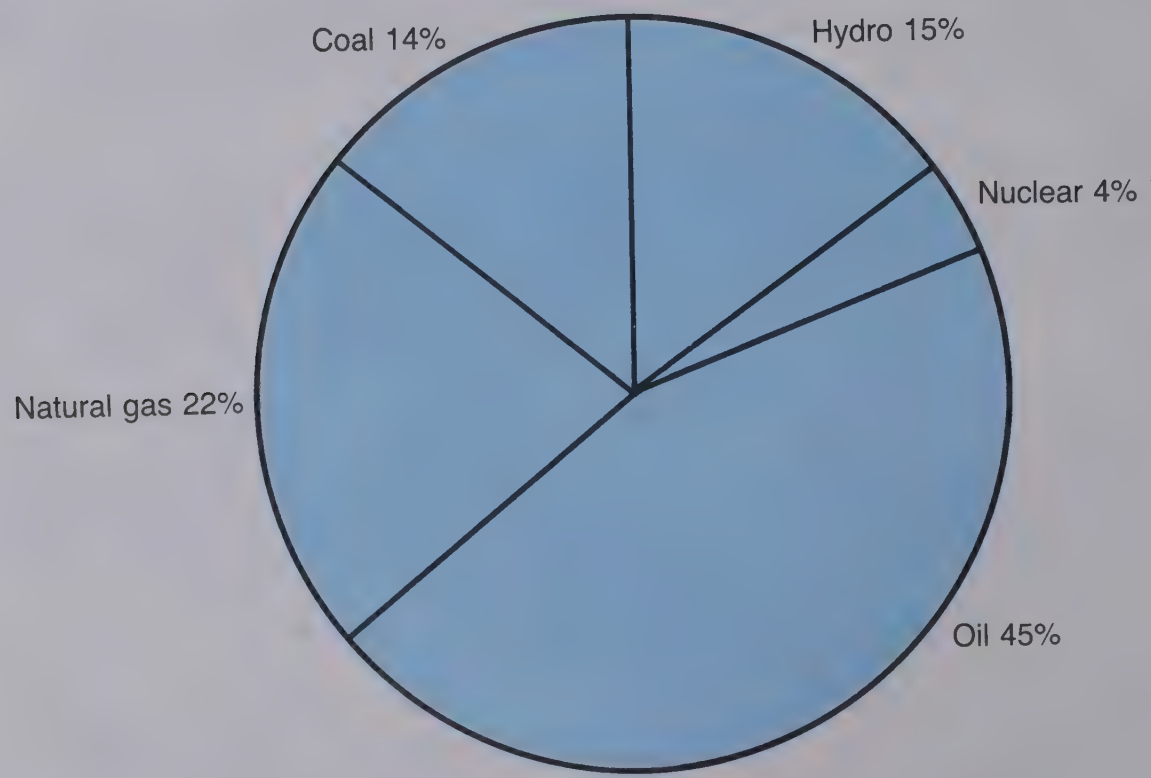
Oil: The Amount We Use

Before 1850, most of the energy that we needed to help us get things done was supplied by animals. We had no trouble growing the food they needed to keep them going. Thus, animals were a renewable source of energy. After 1850, we started using the steam engine. It was fueled first with wood and then with coal. A few years later, oil was discovered. It was cheaper to use than wood or coal. Machines were soon made to run on oil. From this point, we began to depend more and more on a nonrenewable source of energy.

Today, we use several sources of energy, but our main source is oil. Look at the following graph. Which of these sources of energy are renewable? Which are nonrenewable?

We North Americans use more oil than anyone else in the world. We use it every time we drive our cars. We use it every time we throw a plastic garbage bag away. We use it in our homes, our schools, our offices, and our factories. If you look around you at all the things made from oil, you will see that we also waste a great deal of it.

The problem is that we don't have enough oil to satisfy all of our needs. At the moment, we have to buy some oil from other parts of the world. But, in time, this oil will run out. What will we do then?

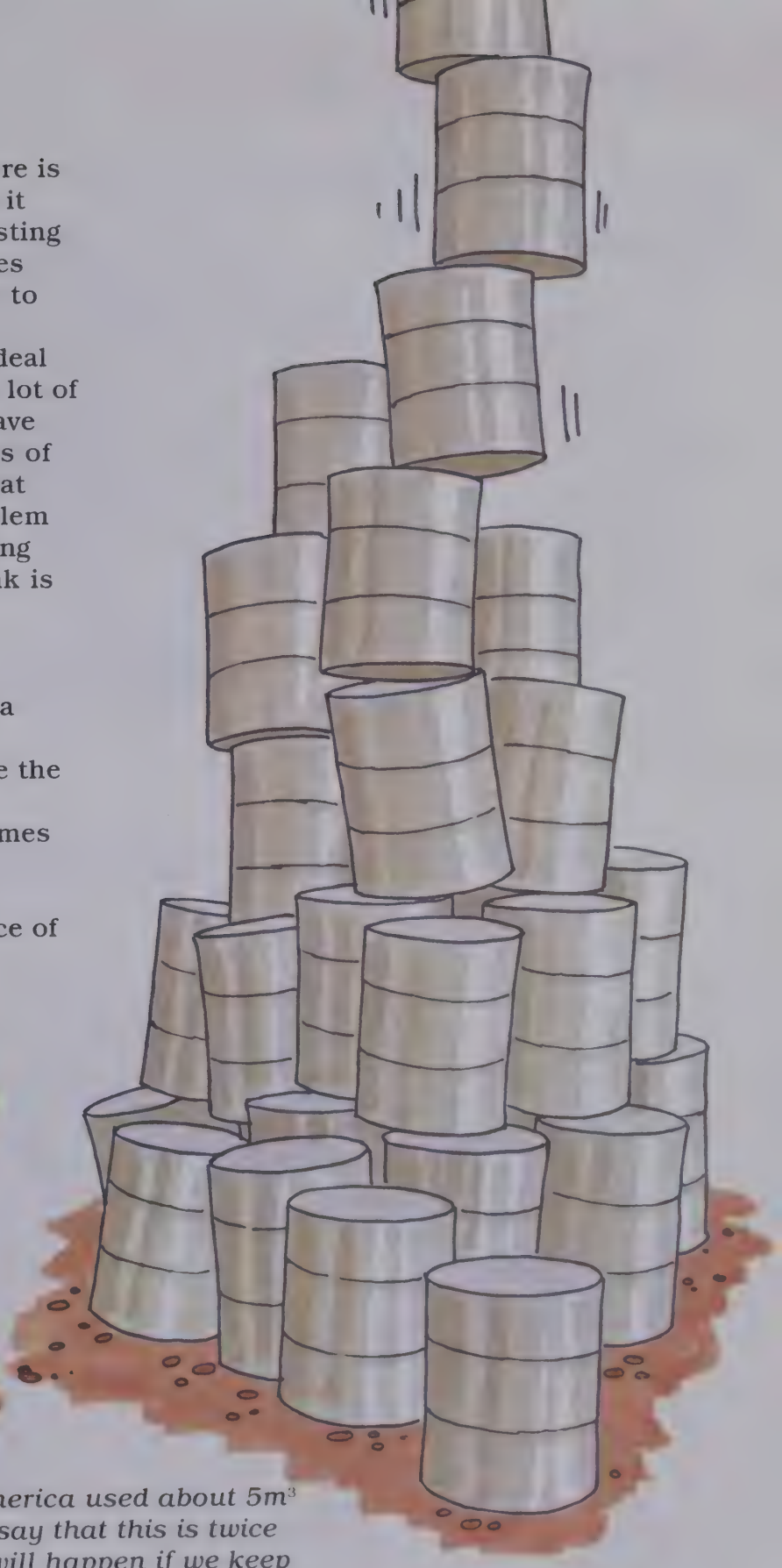


No one knows how much oil there is left in the world. We do know that it won't last forever. As well, it is costing more and more to find new sources of oil. Soon we might not be able to afford to use the oil we find.

There are two possible ways to deal with the problem. We might find a lot of oil and continue to use it as we have in the past. Or we could find ways of using the oil we have wisely so that it will last longer. This is the problem that many oil experts are now talking about. Which solution do you think is best? Why?

Answer these questions:

1. Why was there a shift to oil as a source of energy?
2. Which energy source do we use the most?
3. In the whole world, who consumes the most oil?
4. In what do we use oil?
5. What is the future of this source of energy?



In 1978, each person in North America used about 5m^3 or 29 barrels of oil. Some experts say that this is twice the amount used in 1968. What will happen if we keep using twice as much oil every ten years?

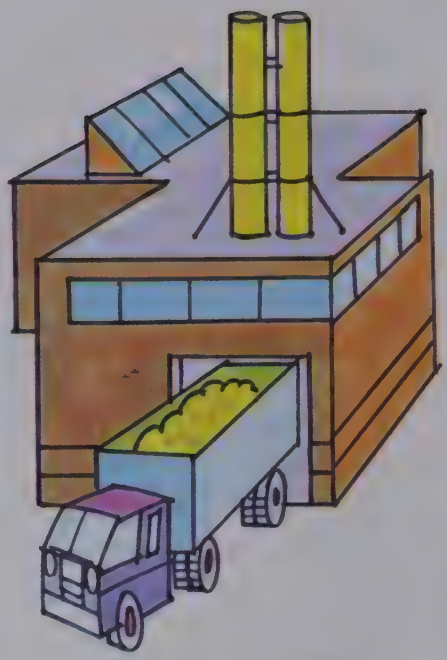
ACTIVITY 15

The Long and the Short of It

Short Chain

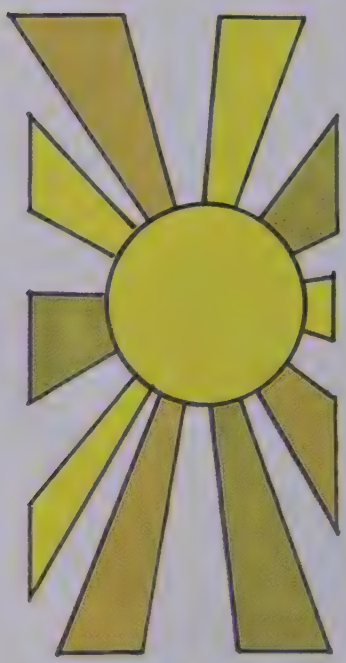
Sun shines

Plants grow



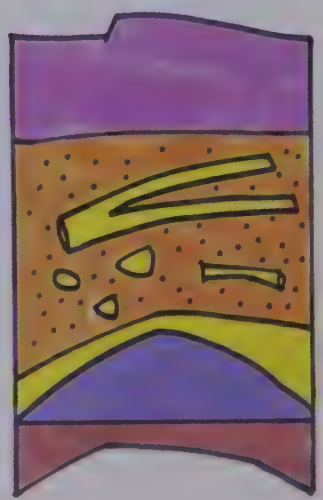
Food processed

Long Chain

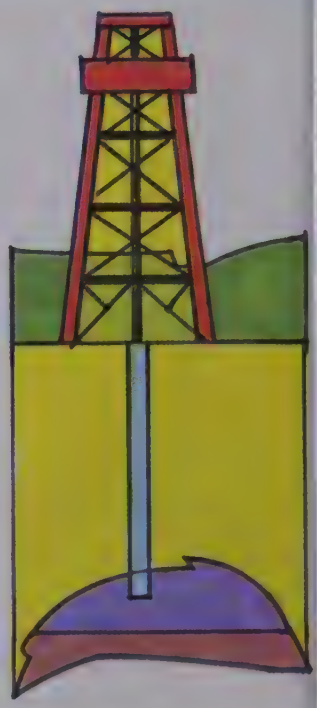


Sun shines

Plants, tiny animals live



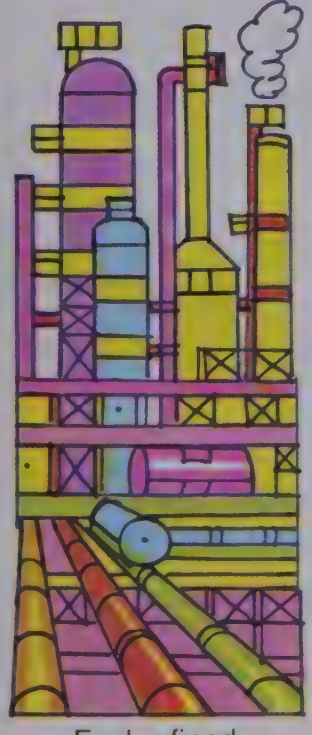
Plants, tiny animals die and form fossil fuel



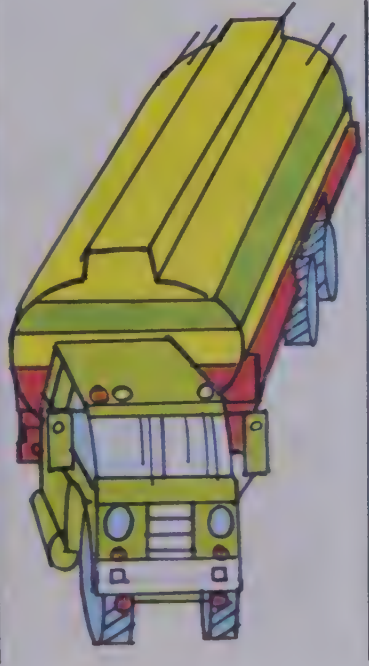
Fuel extracted

Food eaten

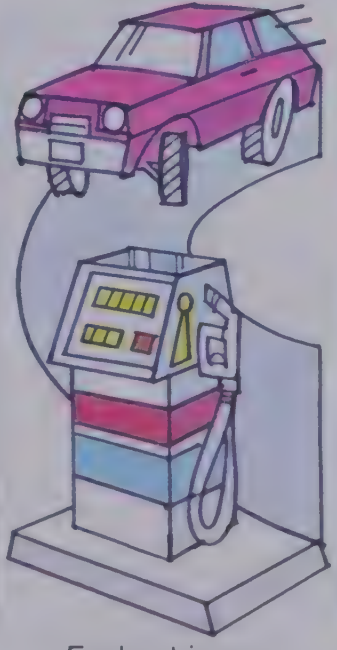
Walk to school



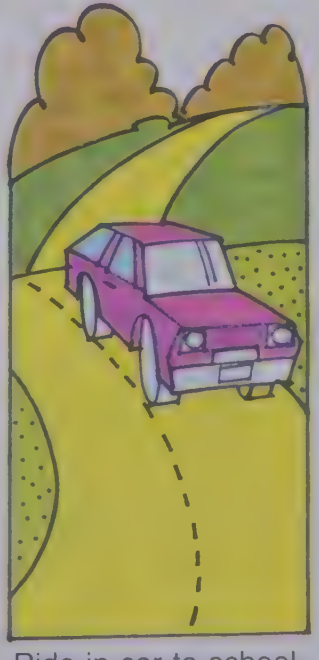
Fuel refined



Fuel taken to station



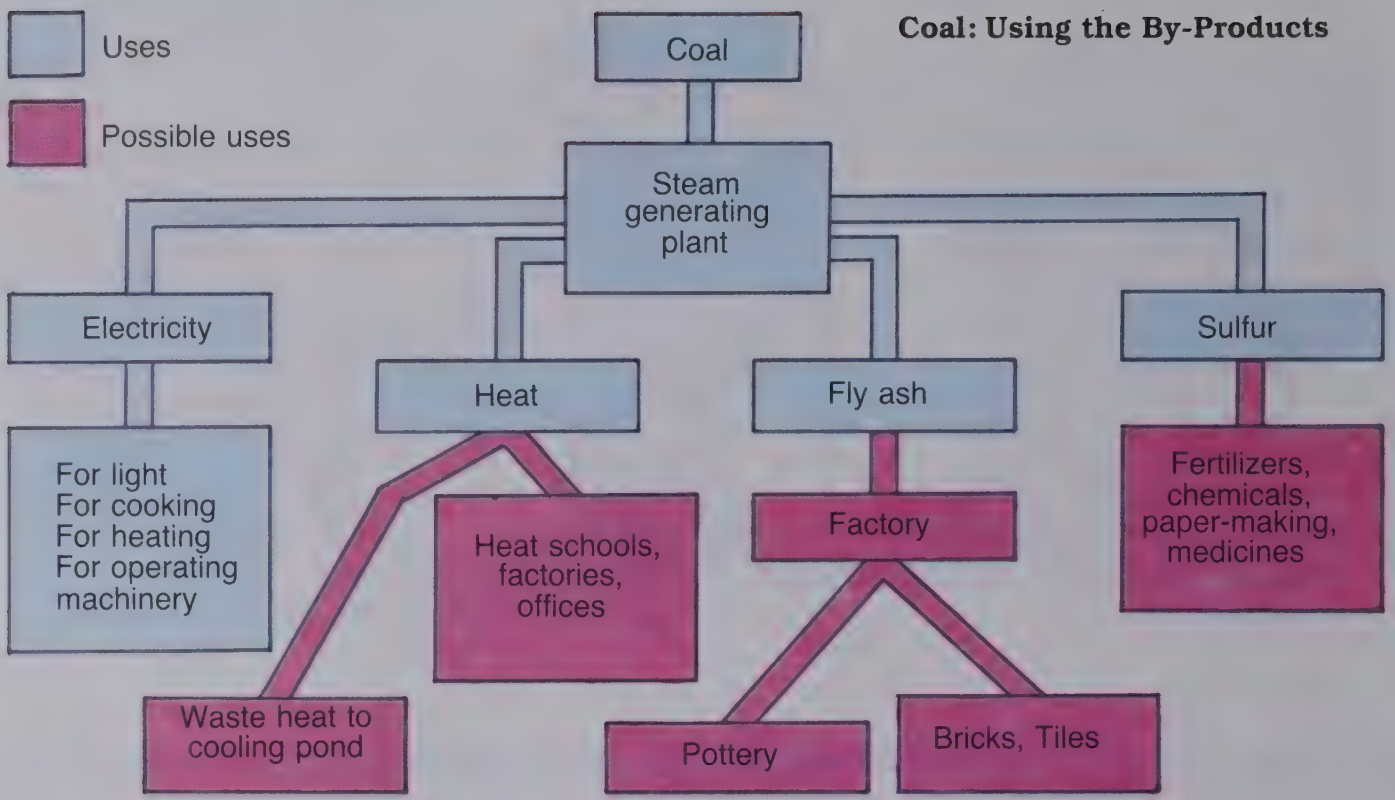
Fuel put in car



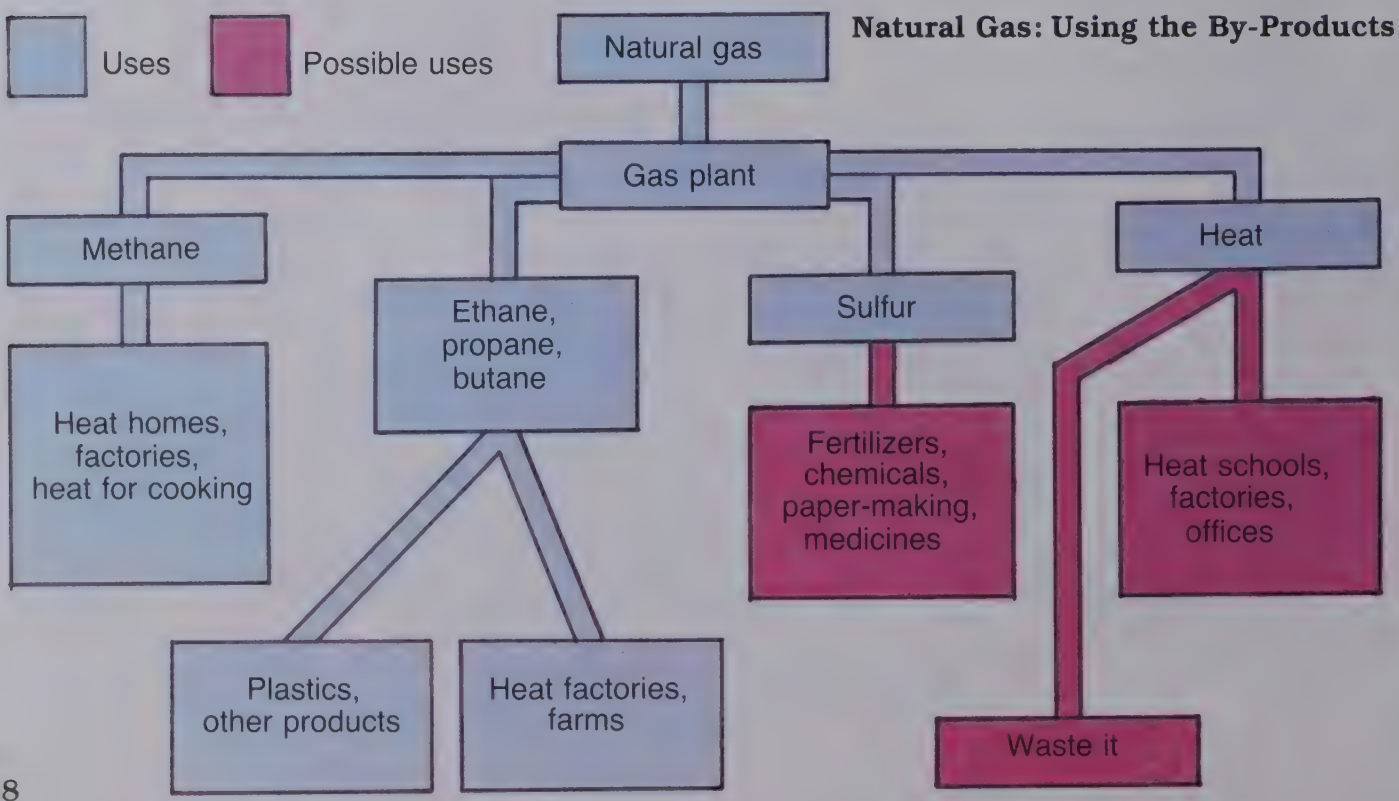
Ride in car to school

ACTIVITY 16

Use It If You Can



Coal: Using the By-Products



Natural Gas: Using the By-Products

Potatoes: Using the Waste

Some years ago a large potato company changed the way it got rid of its waste water. The company began to sprinkle it over nearby sand dunes. The once bare land is now covered with wild plants. And where once windblown sand was the only thing moving, rabbits, owls, and coyotes have come to live. Cattle and sheep also graze here, keeping the "jungle" down.

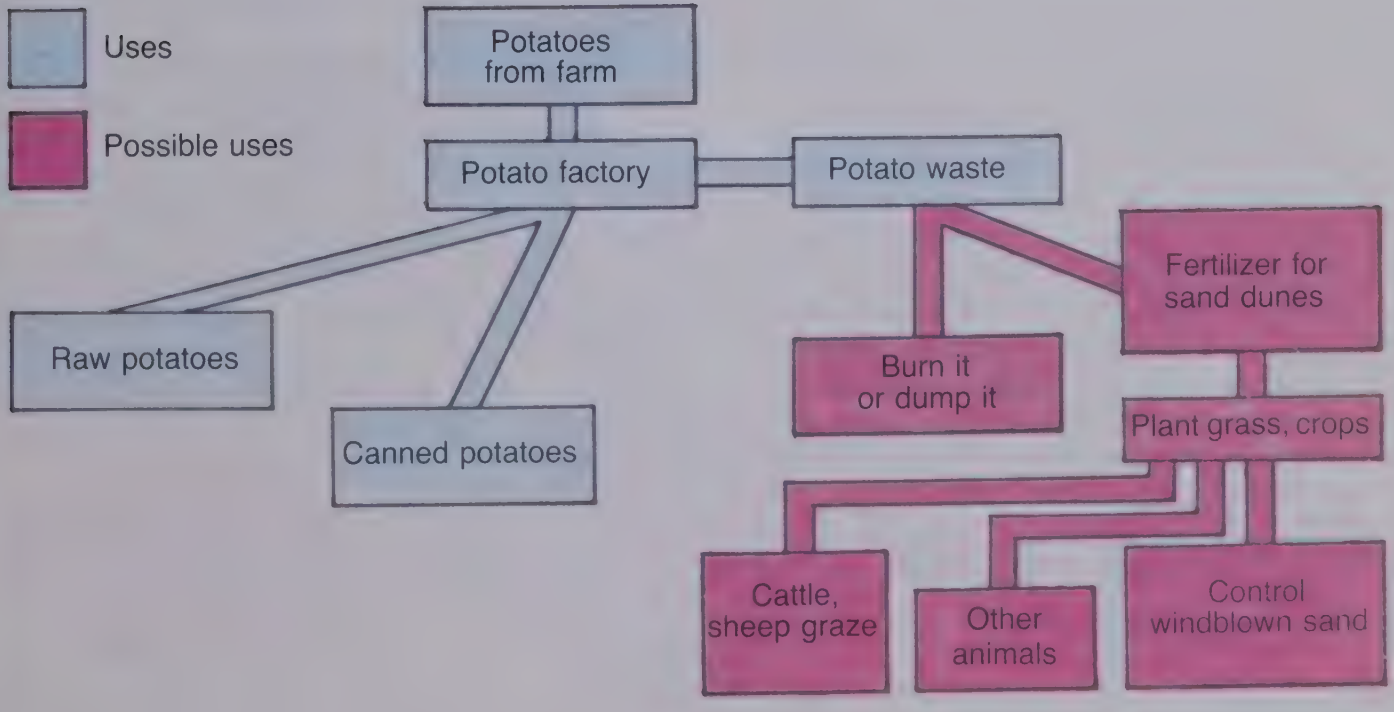
Each day almost five million litres of water is sprayed over the 80-ha site. Most of this waste water has been used in cleaning the potatoes. The water is sent to the area through a hose 6.4 km long.

Although the company's main aim was to get rid of its waste water, the waste makes money. The company can keep about forty cattle on the land now. The wild plants they feed on are not usual cattle feed. Still, they seem to like it. Their mass increases by a kilogram a day.

Soil scientists say that the wild growth anchors the sand. Nearby farms no longer have their rich soil thinned by blowing sand. But attempts to plant crops on the land have not worked. Only wild plants seem to be able to live on the waste water. Still, the large area of land is better than it was before. And so far there have been no bad effects. Should the plan ever prove harmful, it can be stopped. The hose can be turned off. In a short while, the land would change back to sand dunes.

Answer these questions:

1. How does the large potato company reuse its wastes?
2. Give three ways that this reuse helps the environment around the plant.
3. Give two reasons why this is good for the company.
4. Can you think of other industries like the potato company that could make good use of waste waters?



ACTIVITY 17

Decisions, Decisions

You are a member of the town council. It is your job to decide if a new source of energy should be used or not. In each case, answer the following questions to help you make your decision.

1. How is the energy to be used?
2. Is the energy renewable or nonrenewable?
3. How will the new source affect your town's environment?
4. What are the advantages of using the energy source?
5. What are the disadvantages of using the energy source?
6. What is your decision? Yes or no?
7. What are your reasons for deciding as you did?

Case 1

Your government wants to build a large hydroelectric plant near your town. The plant will supply energy to heat homes and run factories. To do this, a huge dam must be built. The dam will flood most of the farms around your town.

The government has promised to pay the farmers well for the land they will lose. But the farmers have no other skills to use to earn their living. They do not want the dam built. The land that will be lost is the only farming land near your town. Your town will always have to bring in its food supplies.

If the plant is not built, your town will need to buy its energy at twice the cost from another area. The cheap source of energy from the plant would attract many factories. This would mean more jobs for the many people out of work in your town.

Decide whether the dam should be built or not.

Case 2

You live in a very pretty town on a large lake. Many people come here to fish and swim. The hotels and restaurants in your town need these visitors as customers.

A company wants to build a coal-fired generating plant on the shores of your lake. The coal will be brought to the plant by trains. Many railway lines will have to be built. This will spoil the view around your town. The company says that the plant will not harm the air or the town's tourist business. It will be far enough away.

The energy generated by the plant will be used mainly by a large city 100 km away. Some of the people in your town work in this city. If the plant is built, more people will be able to work in the city.

Decide whether the plant should be built or not.

Case 3

An oil company wants to build a refinery in your city. This will mean many new jobs for your city. The oil products will be cheaper, too.

There are only two spots where the refinery can be built. One area is a park. The other is an area where a few hundred people live.

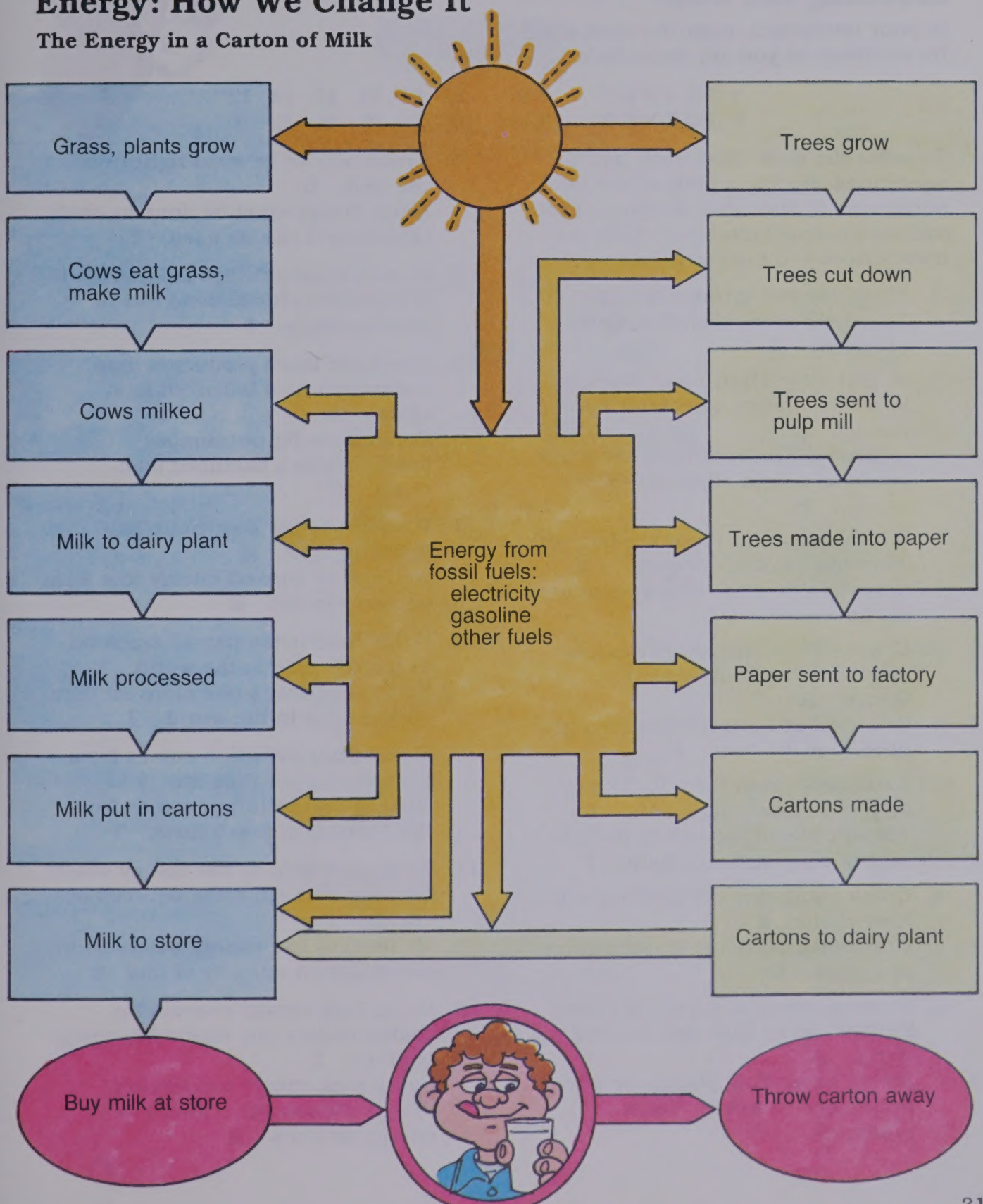
One group of people does not want the park destroyed. They feel there are too few parks now. A second group of people says the refinery would spoil the area where they live. They want it built in the park. A third group feels the refinery would spoil the air and be too noisy. This group does not want it built at all.

Decide whether or not the refinery should be built. If you decide to build it, decide where it will be built.

ACTIVITY 18

Energy: How We Change It

The Energy in a Carton of Milk



ACTIVITY 19

Cracking the Code

In your notebooks, copy the code and its numbers as you see them here.

1	2	3	4	5	6	7		8	9		10	11	12	13	14	15
U	J	Q	T	V	G	T		K	U		D	G	V	V	G	T

To solve the code, read each pair of sentences. Decide which of the two sentences is true. Put the letter that follows the true statement under the code letters you have written.

1. There are two forms of energy. **T**
   There are more than two forms of energy. **S**
2. A light object moving at the same speed as a heavy object has more energy. **O**
   A heavy object moving at the same speed as a light object has more energy. **H**
3. Steam and water vapor are harmful by-products of conversion. **M**
   Noise can be a harmful by-product of conversion. **O**
4. Crude oil and natural gas can be used to make many useful things. **R**
   Crude oil and natural gas are only used to make heat. **S**
5. Extracting fossil fuels is the first step in a conversion chain. **L**
   The shining of the sun is the first step in a conversion chain. **T**
6. Green plants are the producers in a food chain. **E**
   Green plants are the prime source of energy. **B**
7. Steam generating plants are often built in areas with fast-flowing rivers. **A**
   Steam generating plants are often built close to where coal is found. **R**
8. Crude oil can be used right from the well. **C**
   Many things must be done to crude oil before it can be used. **I**
9. Gravity makes things fall down. **S**
   A stretched elastic band has no stored energy. **P**
10. There are more producers than consumers in a balanced food chain. **B**
    Consumers far outnumber producers in a balanced food chain. **D**
11. We can use the electricity in a lightning bolt. **Q**
    We need to convert energy to a form we can control. **E**
12. North Americans use as much oil as anyone else in the world. **V**
    North Americans use more oil than anyone else in the world. **T**
13. Most of our pollution comes from the refining of crude oil. **F**
    Most of our pollution comes from the burning of fossil fuels. **T**
14. We do not need to use energy wisely because we have many sources of energy. **F**
    We need to use energy wisely so we can maintain our way of life. **E**
15. Using long energy conversion chains wastes our renewable energy sources. **L**
    Using long energy conversion chains wastes our nonrenewable energy sources. **R**

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